Journal of Crop and Weed, 9(2):44-49(2013)

Correlation and path coefficient analysis in tuberose

VANLALRUATI , T. MANDAL AND S. PRADHAN

Department of Floriculture and Landscaping, Faculty of Horticulture
Bidhan Chandra Krishi Viswavidyalaya
Mohanpur-741252, West Bengal

Received: 18-09-2013, Revised: 29-10-2013, Accepted: 15-11-2013

ABSTRACT

Genetic variability studies in tuberose were carried out among 11 varieties for 18 characters at Horticultural Research Farm of Bidhan Chandra Krishi Viswavidyalaya. Days to spike emergence (DAP), length of flower spike and number of spikes per plot showed highest phenotypic and genotypic variance. Higher heritability associated high genetic advance was observed for length of rachis indicating the presence of additive gene action. A study on the association of various morphological traits through correlation and path co-efficient analysis showed that leaf area, diameter of florets, length of florets, length of flower spike, weight of flower spike, florets spike^{-1}, length of rachis and weight of 10 florets exhibited significant and positive correlation with that of spike yield. Spike weight imparted maximum positive direct effect on spike yield followed by field life, floret diameter, florets per spike and spike diameter. Similarly, weight of 10 florets imparted maximum negative direct effect on spike yield followed by leaf area and spike length.

***Keywords*:** Correlations, heritability, tuberose and variability

Tuberose (*Polianthes tuberosa* Linn.) is one of the most important commercial bulbous ornamentals due to its potentiality for cut flower trade, long vase life and essential oil industry, attractive long spikes, high cut-flower yield and nearly year round yield in tropical and subtropical climates (Benschop, 1993; Singh, 1995). There is a tremendous scope for improvement especially with spike related traits through inter and intra specific hybridization programmes. A study on such traits will be essential for a successful breeding programme. In tuberose, like any other plant species, the phenotypic expression of a character is mainly governed by the genetic make-up of the plant, the environment in which it is grown and the interaction between the genotype and environment. Further, the genotype of a plant is controlled by additive gene effect (heritable), non-additive gene effect or dominance (non-heritable) and epistasis (non-allelic interaction). Apportioning of the phenotypic variability into its heritable and its non-heritable components with suitable genetic parameters such as genotypic and phenotypic co-efficient of variation, heritability and genetic advance is necessary. (Murthy and Srinivas, 1997; Kannan *et al.*, 1998; Radhakrishna *et al.*, 2004; Vijayalaxmi *et al.*, 2012). Thus, the present study was taken up to know the genetic variability in tuberose which can be used in tuberose improvement programme.

MATERIALS AND METHODS

An investigation was carried out at Horticultural Research Farm of Bidhan Chandra Krishi Viswavidyalaya at Mondouri, during 2009 and 2010 with eleven tuberose varieties *viz*., *Calcutta Single*, *Calcutta Double*, *Phule Rajani*, Swarna Rekha, *Prajwal*, *Vaibhav*, *Hyderabad Single*, *Hyderabad Double*, *Rajat Rekha*, *Sikkim Selection* and *Hybrid CG-T-C-4* which were selected due to their quality and ease in availability. The experiment was conducted using Randomised Block Design with three replications. Necessary agronomic package and practices were followed to grow a successful crop (Singh, 1995). Representative plants were marked in each replication and close observations were noted regularly.

The observations recorded come under following vegetative parameters, including height of the plant, no of leaves per clump, leaf area; reproductive parameters including days to spike emergence, days for spike emergence to floret opening, diameter of floret, length of flower spike, rachis length; yield parameters like number of spikes per plot and number of florets per spike and quality parameters like self-life of spike in the field from five plants of randomly chosen from each treatment and average was worked out for statistical computation. Phenotypic and genotypic variance and coefficient of variation were estimated as suggested by Singh and Choudhary (1979). Heritability in broad sense was estimated as a ratio of genetic variance to phenotypic variance (Falconer, 1981). Genetic advance was calculated using the formula given by Johnson *et al*. (1955). Path co-efficient analysis was carried out using the phenotypic correlation co-efficient as suggested by Wright (1921) and illustrated by Dewey and Lu (1959). Standard path co-efficient which are the standardized partial regression co-efficient were obtained by as described by Goulden (1959).

RESULTS AND DISCUSSION

Significant differences were observed for all the characters studied among all the varieties. The variability parameters showing phenotypic and

Email: maruat_09@yahoo.com

genotypic variance, co-efficient of variation, heritability in broad sense and genetic advance as a percentage over mean along with their mean values and range are presented in table- 1 and 2.

It was obvious that days to spike emergence (DAP), length of flower spike and number of spikes per plot showed highest phenotypic and genotypic variance. Genotypic variance was low for days for spike emergence to floret opening (7.40) and diameter of the floret (0.25) indicating the non- heritable variation of the characters. The estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters studied, indicating thereby high degree of environmental influence. Higher GCV and PCV estimates for number of florets per spike, rachis length, plant height, number of leaves per clump and leaf area indicates the presence of considerable variability in these traits and scope of selection and improvement. Higher heritability associated with highest genetic advance was observed for length of rachis, indicating the presence of additive gene action. The other trait exhibited high heritability associated with moderate and low genetic advance, indicating the presence of non- additive gene action. Similar genetic behavior has been reported by Panse (1957) and Sheikh *et al*. (1995). This also suggests that high heritability is not always associated with high genetic advance (Pant and Lal, 1991). Minimum differences between the PCV and GCV were observed for characters like days to spike emergence, leaf area, length of flower spike and length of rachis which indicate little influence of environment on the phenotypic expression of the mentioned characters.

The phenotypic and genotypic correlation coefficients were computed in all possible combinations for 14 quantitative characters and are presented in Table 3. In the present study, the genotypic correlation co-efficient were observed to be higher than the phenotypic correlation co-efficient for most of the characters studied. This indicated that these differences might be due to mostly genetic makeup of the varieties and not due to environmental variations

The result shows that diameter of floret and fresh weight of individual floret was significantly and positively correlated with that of days required for first floret opening. Length of spike, height of plant and number of leaves per clump were found significant but negatively correlated with days required for first floret opening.

Leaf area, rachis length, field life, ten florets weight, floret length, floret width and spike weight were significantly and positively correlated with number of florets per spike. Balaram and Janakiram (2009) also reported positive and significant correlation of rachis length and floret length with number of florets per spike in gladiolus. Positive association of rachis length with number of florets per spike was also reported by Radhakrishna *et al.* (2004).

Leaf area, diameter of florets, length of florets, length of flower spike, weight of flower spike, florets/ spike, length of rachis and weight of 10 florets are significantly and positively correlated with that of spike yield whereas negative correlation with spike yield was observed for days to flowering. Positive association of flower yield with diameter of florets, length of florets, florets per spike, length of rachis and weight of 100 florets was also reported by Niranjan *et al.* (1997). The result was also in accordance with the findings of Kannan *et al*. (1998) and Radhakrishna *et al.* (2004).

The direct and indirect effects of the different characters on spike yield were presented on table 4. From the phenotypic path analysis, positive direct effects of independent characters *viz.* floret diameter, spike diameter, spike weight and florets per spike was observed whereas floret length, spike length, rachis length, plant height, leaves per clump, leaf area, 10 florets weight and number of days taken for flowering incurred negative direct effects towards spike yield. Spike weight imparted maximum positive direct effect (2.066) on spike yield followed by field life, floret diameter, florets per spike and spike diameter. Similarly, 10 floret weight imparted maximum negative direct effect (-2.809) on spike yield followed by leaf area and spike length. Yield was also positively and significantly correlated with floret diameter, spike diameter, spike weight, florets/spike, field life and chlorophyll content. Significant improvement in the number of florets per spike, spike weight and floret diameter etc. is generally expressed in terms of yield and therefore there was a positive correlation.

Correlation coefficient of yield with floret length, spike length, rachis length, leaf area and 10 floret weights was highly significant but the direct effect was negative. Therefore, indirect effects were mainly responsible for yielding of such correlation coefficient. Therefore, it would be better to consider the other characters that showed high indirect effect on spike yield. On the basis of phenotypic path analysis, weight of spike had the highest positive direct effect on yield. Comparatively higher direct effects on yield were also exerted by floret diameter, spike diameter and florets/spike. The significant positive correlation coefficients were recorded for floret length, spike length, rachis length, leaf area and

10 floret weights despite their negative effect and positive correlation may be influenced via indirect positive effect of spike weight, floret diameter, spike diameter and florets/spike. Direct positive effect of florets per spike on flower yield was also reported by Kannan *et al*. (1998). Vijayalakhsmi *et al*. (2012) also reported that fresh weight of spike had direct positive effects on flower yield per plant in tuberose.

The present study suggests direct selection of varieties based on the characters exhibiting high positive direct and indirect effects with positive correlations namely spike weight, floret diameter, floret length, spike diameter and florets/spike, spike length, rachis length. High heritability, GCV and PCV estimates for number of florets per spike, rachis length, plant height, number of leaves per clump and leaf area also suggests selection of varieties based on these traits for selection and further improvement through effective breeding programme.

REFERENCES

Balaram, M.V. and Janakiram, T. 2009. Correlation and path coefficient analysis in gladiolus. *J. Ornam. Hort.,* **12**: 22-29.

Benschop, M. (1993). Polianthes. In. *The Physiology of Flower Bulbs* (Eds.) Elsevier, Amsterdam, pp.589-601.

Dewey, D.R. and Lu, K.U. 1959. A correlation path co-efficient analysis of components of crested wheat wheat grass production. *Agron. J*., **51**: 515-18.

Falconer, D.S. 1981. *Introduction to Quantitative Genetics*. Oliver and Boyd. Ltd. Edinburgh.

Goulden, C.H. 1959. *Methods of Statistical Analysis*. John Wiley and sons, Inc., New York.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soyabean. *Agron. J*., **47**: 314-18.

Kannan, P., Rajalingam, G.V. and Haripriya, K. 1998. Correlation and path coefficient analysis in tuberose (*Polianthes tuberosa* L.). *J. Spices Aromatic Crops,* **7**: 149-53.

Murthy, N. and Srinivas, M. 1997. Genotypic performance and character association studies in tuberose (*Polianthes tuberosa* L.). *J. Ornam. Hort.,* **5**: 31-34.

Panse, V.G. 1957. Genetics of quantitative charaters in relation to plant breeding. *Indian J. Genet*., **17** : 318-28.

Pant, C.C. and Lal, S.D. 1991. Genetic Variability in Gladiolus. *Prog. Hort*., **23**: 1-4.

Radhakrishna, K.N., Janakiram, T. and Srinivas, M. 2004. Correlation studies in tuberose (*Polianthes tuberose L.). J. Ornam. Hort.,* **7**: 110-16.

Sheikh, M.K., John, A.Q., Siddique, M.A.A. and Paul, T.M. 1995. Genetic variability in gladiolus. *J. Ornam. Hort.,* **3**: 23-25.

Singh, K.P. 1995. Improved production technologies for tuberose (*Polianthes tuberosa* L.), a review of research done in India. Indian Institute of Horticultural Research, Hessargarhatta, Banglore, India. *(CAB Abst.,* 1996-1998/07).

Singh, R.K. and Choudhary, B.D. 1979. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani Publ., Ludhiana.

Vijayalaxmi, M., Rao, A.M., Padmavatamma, A.S. and Shankar, A.S. 2012. Correlation and path coefficient analysis in tuberose. *Res. Crops*., **13**: 302

Wright, S. 1921. Correlation and causation. *J. Agril. Res.,* **20:** 557-85.

Table 1: Heritability, genetic advance and genetic advance over mean (%) in tuberose

Sl. No.	Character	Heritability (%)	Genetic advance	Genetic advance over mean (K=2.08)
1.	Height of the plant (cm)	73.81	10.73	29.20
2.	Number of leaves per clump	91.83	10.85	32.93
3.	Leaf area (cm^2)	98.61	18.29	34.92
4.	Days to spike emergence (DAP)	90.12	19.69	10.60
5.	Days for spike emergence to floret opening	66.51	4.64	16.84
6.	Length of flower spike (cm)	92.76	25.28	30.06
7.	Length of rachis (cm)	94.43	18.63	58.36
8.	Diameter of floret (cm)	86.36	0.97	23.50
9.	Self- life of spike in the field (days)	88.11	11.40	45.19
10.	Number of florets per spike	92.24	18.64	42.96
11.	Number of spikes per plot	67.82	14.62	21.25

Table 2: Variations of growth and floral characters in eleven tuberose cultivars

Sl. No.	Characters	Range	Mean ± SEm	Variance		Coefficient of variation (%)		LSD (0.05)
				Pheno.	Geno.	Pheno.	Geno.	
1.	Height of the plant (cm)	26.62-46.99	36.27 ± 2.03	48.65	35.90	19.23	16.52	**5.69**
2.	Number of leaves per clump	24.76-41.92	32.56 ± 0.95	32.10	29.46	17.40	16.67	**5.08**
3.	Leaf area (cm^2)	37.60-66.99	51.82 ± 0.66	78.80	77.70	17.13	17.01	**1.84**
4.	Days to spike emergence (DAP)	167.40-200.33	185.80 ± 1.91	110.59	99.55	5.66	5.37	**5.34**
5.	Days for spike emergence to floret opening	22.44-31.33	27.17 ± 2.21	11.11	7.40	12.27	10.01	**3.12**
6.	Length of flower spike (cm)	60.00-95.96	83.20 ± 2.03	170.84	158.46	15.71	15.13	**5.69**
7.	Length of rachis (cm)	19.23-46.39	31.92 ± 1.30	90.79	85.75	29.85	29.01	**3.64**
8.	Diameter of floret (cm)	3.29-4.86	4.08 ± 0.11	0.29	0.25	13.14	12.21	**0.32**
9.	Self- life of spike in the field (days)	15.41-34.43	25.24± 1.24	38.83	34.20	24.69	23.17	**3.47**
10.	Number of florets per spike	30.56-56.27	43.37± 1.56	94.80	87.43	22.45	21.56	**4.38**
11.	Number of spike per plot	52.33-84.44	67.82 ± 1.22	106.97	102.53	15.25	14.93	**3.42**

Note: Pheno.-Phenotypic, Geno.-Genotypic

Table 3: Genotypic and phenotypic correlation among the fourteen characters of tuberose variety

Characters		Floret lt (cm)	Spike lt (cm)	Spike dia (cm)	Spike wt(g)	Florets Spike^{-1}	Rachis lt (cm)	Plant height (cm)	Leaves per clump	Leave area (cm^2)	Field life (days)	10 florets wt (g)	Days to flowering	Chloro phyll cont (mg.g^{-1})	Spike yield plot^{-1}
Floret diameter	G	1.254	0.053	0.817**	0.946**	0.919**	0.683**	0.022	-0.338	0.598**	0.644**	1.013	0.541**	0.378*	0.693**
	P	0.690**	0.065	0.457**	0.817**	0.814***	0.596**	-0.031	-0.339	0.563**	0.595**	0.915**	0.402*	0.270	0.609**
Floret length	G	1.000	0.035	0.790**	1.074	1.070	0.835**	-0.076	-0.436*	0.716**	0.889**	1.236	0.634**	0.453**	0.793**
	P	1.000	0.203	0.485**	0.658**	0.646**	0.461**	0.095	-0.255	0.394*	0.465**	0.725**	0.295	0.146	0.477**
Spike length	G		1.000	0.552**	0.262	0.319	0.493**	0.722**	0.336	0.743**	0.700**	0.101	-0.837**	0.776**	0.589**
	P		1.000	0.425*	0.259	0.270	0.453**	0.621**	0.308	0.672**	0.595**	0.088	-0.680**	0.606**	0.549**
Spike diameter	G			1.000	0.748**	0.970**	1.153**	0.076	-0.042	0.884**	0.937**	0.745**	-0.026	0.732**	1.116
	P			1.000	0.504**	0.633**	0.788**	0.079	-0.013	0.586**	0.587**	0.522**	0.103	0.432*	0.791**
Spike weight	G				1.000	0.788**	0.680**	0.281	-0.203	0.781**	0.661**	0.937**	0.261	0.604**	0.745**
	P				1.000	0.728**	0.647**	0.270	-0.187	0.712**	0.611**	0.851**	0.192	0.442*	0.681 **
Florets Spike^{-1}	G					1.000	0.810**	0.180	0.038	0.725**	0.803**	0.857**	0.272	0.538**	0.857**
	P					1.000	0.740**	0.100	0.028	0.694**	0.728**	0.788**	0.256	0.427*	0.788**
Rachis length	G						1.000	0.119	-0.014	0.787**	0.787**	0.682**	0.062	0.651**	0.973**
	P						1.000	0.119	-0.021	0.757**	0.718 **	0.659**	0.088	0.534**	0.936**
Plant height	G							1.000	0.527**	0.627 **	0.291	-0.007	-0.590**	0.859**	0.295
	P							1.000	0.399*	0.520 **	0.266	0.018	-0.541**	0.522**	0.250
Leaves per clump	G								1.000	0.246	0.057	-0.375*	-0.489**	0.324	0.129
	P								1.000	0.230	0.025	-0.365*	-0.402*	0.303	0.149
Leave area	G									1.000	0.790 **	0.608**	-0.287	0.942**	0.893**
	P									1.000	0.732**	0.598**	-0.232	0.786**	0.871 **
Field life	G										1.000	0.687**	-0.102	0.558**	0.811**
	P										1.000	0.629**	0.112	0.435	0.729**
floret weight	G											1.000	0.501**	0.329	0.663**
	P											1.000	0.430	0.278	0.633**
Days to	G												1.000	0.474*	-0.086
flowering	P												1.000	0.311	-0.028
Chlorophyll cont	G													1.000	0.799**
	P													1.000	0.675**

*Note: *, ** significant at ficant at 5 % and 1% level, respectively*

Table 4: Phenotypic path coefficient of 14 characters on dependable variable yield

Characters	Floret dia (cm)	Floret length (cm)	Spike length (cm)	Spike dia (cm)	Spike wt(g)	Florets Spike^{-1}	Rachis length (cm)	Plant height (cm)	Leaves per clump	Leave area (cm^2)	Field life (days)	10 floret wt(g)	Days to flowering	Chlorophy-ll cont. (mg.g^{-1})	Spike yield plot^{-1}
Floret dia. (cm)	0.714	-0.038	-0.045	0.500	1.954	0.189	-0.016	-0.006	0.012	-0.607	0.843	-2.846	0.203	0.242	0.693**
Floret lt.(cm)	0.896	-0.030	-0.030	0.483	2.219	0.220	-0.020	0.022	0.015	-0.727	1.163	-3.472	-0.238	0.290	0.793**
Spike lt.(cm)	0.038	-0.001	-0.846	0.338	0.540	0.066	-0.012	-0.211	-0.012	-0.755	0.916	-0.284	0.314	0.497	0.589**
Spike dia (cm)	0.583	-0.024	-0.467	0.612	1.545	0.199	-0.027	-0.022	0.001	-0.898	1.225	-2.091	0.010	0.469	1.116**
Spike wt. (g)	0.676	-0.032	-0.221	0.458	2.066	0.162	-0.016	-0.082	0.007	-0.793	0.865	-2.632	-0.098	0.387	0.745**
Florets spike^{-1}	0.657	-0.032	-0.270	0.594	1.628	0.206	-0.019	-0.053	-0.001	-0.736	1.051	-2.408	-0.102	0.345	0.857**
Rachis length (cm)	0.488	-0.025	-0.418	0.705	1.405	0.167	-0.024	-0.035	0.001	-0.789	1.029	-1.916	-0.023	0.417	0.973**
Plant height (cm)	0.015	0.002	-0.611	0.046	0.581	0.037	-0.003	-0.293	-0.018	-0.636	0.381	0.020	0.222	0.551	0.295
Leaves per clump	-0.242	0.013	-0.284	-0.026	-0.420	0.008	0.001	-0.154	-0.035	-0.249	0.074	1.052	0.184	0.208	0.129
Leave area (cm^2)	0.427	-0.021	-0.629	0.541	1.614	0.149	-0.019	-0.183	-0.009	-1.015	1.034	-1.708	0.108	0.604	0.893**
Field life (days)	0.460	-0.026	-0.592	0.573	1.365	0.165	-0.019	-0.085	-0.002	-0.802	1.308	-1.931	0.038	0.358	0.811**
10 floret wt (g)	0.724	-0.037	-0.086	0.456	1.936	0.176	-0.016	0.002	0.013	-0.617	0.899	-2.809	-0.188	0.211	0.663**
Days to flowering	0.387	-0.019	0.708	-0.016	0.539	0.056	-0.001	0.173	0.017	0.292	-0.133	-1.408	-0.376	-0.304	- 0.086
Chlorophyll cont. (mg.g^{-1})	0.270	-0.014	-0.656	0.448	1.248	0.111	-0.015	-0.251	-0.011	-0.956	0.730	-0.923	0.178	0.641	0.799**

Note: Residual effect= 0 .306, the diagonal underlined elements are the direct effects